

1. Plasmatron-catalyst apparatus for generating hydrogen-rich gas comprising:

a plasmatron; and

at least one catalyst for receiving an output from the plasmatron to produce hydrogen-rich gas, wherein said at least one catalyst is located at a position downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron. ✓

2. ✓ The apparatus of claim 1 wherein the plasmatron includes means for receiving as an input air, fuel and water/steam.

3. ✓ The apparatus of claim 2 wherein the plasmatron includes means for receiving exhaust gas from an engine or fuel cell.

4. ✓ The apparatus of claim 1 wherein the at least one catalyst includes means for receiving as an input air, fuel and water/steam.

5. ✓ The apparatus of claim 4 wherein the at least one catalyst includes means for receiving exhaust gas from an engine or fuel cell.

6. ✓ The apparatus of claim 2 wherein the at least one catalyst includes a heat exchanger in heat exchange relation with the catalyst to preheat the air, fuel and water/steam.

7. *plurality catalysts* The apparatus of claim 1 including a plurality of catalyst sections, wherein each catalyst section receives additional air/fuel or water/steam.

8. ✓ The apparatus of claim 1 further including a fuel cell for receiving the hydrogen-rich gas, the hydrogen-rich gas having reduced CO content.

9. ✓ The apparatus of claim 8 wherein the plasmatron-catalyst apparatus is in a vehicle.

10. The apparatus of claim 8 wherein the plasmatron-catalytic system is stationary.

11. The apparatus of claim 1 wherein the plasmatron is followed by a fuel injection system for a partial oxidation process, the fuel injection system followed by said at least one catalyst, said at least one catalyst followed by means for water/steam injection and a water-shifting catalyst whereby hydrogen concentration is increased and CO concentration is decreased.

12. The apparatus of any of claims 1-11 wherein said at least one catalyst is selected from the group consisting of a water-shifting catalyst, a partial oxidation catalyst and a steam reforming catalyst.

13. The apparatus of claim 11 wherein said at least one catalyst is a combination of a partial oxidation catalyst, a steam reforming catalyst and a water-shifting catalyst.

14. The apparatus of claim 13 wherein the steam reforming catalyst is followed by the water-shifting catalyst with additional water/steam injection prior to the water-shifting catalyst.

15. The apparatus of claim 2 wherein the water/steam is obtained from oxidizing hydrogen in a fuel cell or by combustion in an engine.

16. The apparatus of claim 15 wherein said combustion in an engine includes combustion in a diesel engine.

17. The apparatus of claim 2 wherein the water/steam is obtained from the exhaust from a diesel engine.

18. The apparatus of claim 1 wherein the hydrogen-rich gas is used for reduction processes in metallurgy and chemistry.

1 19. The apparatus of claim 1 wherein the hydrogen-rich gas is used for hydrogenation as in food  
2 processing and fuel upgrading. *nv wk*

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4 20. The apparatus of claim 1 further including a non-thermal catalytic reaction element to  
5 selectively oxidize CO to CO<sub>2</sub>.

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7 21. The apparatus of claim 11 wherein said at least one catalyst is a combination of a partial  
8 oxidation catalyst, a steam reforming catalyst, and a water-shifting catalyst, wherein  
9 water/steam is added between each of the catalysts.

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11 22. The apparatus of claim 13 wherein the steam reforming catalyst is followed by the water-  
12 shifting catalyst without additional water/steam injection prior to the water-shifting catalyst.

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14 23. The apparatus of claim 1 further including an engine wherein said hydrogen rich gas  
15 generated by said plasmatron-catalyst apparatus is delivered to said engine.

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17 24. The apparatus of claim 1 wherein said position of the at least one catalyst is within 1 to 10  
18 cm downstream from the plasmatron.

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20 25. Plasmatron-catalyst apparatus for generating hydrogen-rich gas comprising:

21 a plasmatron; and

22 a catalytic converter containing at least one catalyst for receiving an output from the  
23 plasmatron to produce hydrogen-rich gas, wherein said at least one catalyst in said catalytic  
24 converter is located at a position downstream from the plasmatron and is activated by  
25 hydrogen and radicals produced in the output of the plasmatron.

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27 26. The apparatus of claim 25 wherein said at least catalyst in said catalytic converter is further  
28 activated and/or preheated by the enthalpy of the output of the plasmatron.

1 27. The apparatus of claim 25 wherein said plasmatron-catalyst apparatus operates in  
2 conjunction with an internal combustion engine.

3  
4 ✓ 28. The apparatus of claim 25 wherein the plasmatron-catalyst apparatus is in a vehicle.

4 28. The apparatus of claim 25 wherein the plasmatron-catalyst apparatus is in a vehicle.

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6 29. The apparatus of claim 25 wherein said position of the at least one catalyst is within 1 to 10  
7 cm downstream from the plasmatron.

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